

Original Article

A morphological and morphometric study of jugular foramen in dry skulls with its clinical implications

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Journal of Craniovertebral Junction and Spine 2014, 5:28

Abstract

Objective: Jugular foramen of human skull is one of the most interesting foramina. It is a complex bony canal, numerous vital structures, including nerves and vessels are transmitted through it. Most of the intracranial and extra cranial lesions of posterior cranial fossa might affect the structures in jugular foramen in addition to intrinsic abnormalities. As the neurosurgeons have become courageous in approaching this area, so there is a need to become familiar with this area. Hence, the present study was done to examine the anatomy of jugular foramen, including its morphological features and dimensions. **Materials and Methods:** The study was carried out on 50 dried skulls. 100 jugular foramina were studied on both right and left side of skulls. The length, width of jugular foramen and width and depth of jugular fossa were measured using vernier calipers. Presence of dome, complete and incomplete septation was also looked for. **Results:** The mean right and left anteroposterior diameter, latero-medial diameter, area, jugular fossa width, depth in our study was 11.22, 16.52, 187.34, 6.83, 11.58 mm and 9.52, 16.02, 153.2, 5.69, 11.13 mm. Dome was present in jugular foramen in 74% on the right side and 58% on the left side. Complete septation in jugular foramen is seen in 44% on the right side and 42% on the left side. **Conclusion:** This study will help the neurosurgeons while doing surgery in this region.

Key words: Dome, jugular foramen, jugular fossa, septation, skull

INTRODUCTION

The jugular foramen lies between the occipital bone and the petrous part of the temporal bone, and it is elongated and irregularly shaped.^[1] It is the chief route for the venous outflow from the skull. The glossopharyngeal, vagus and cranial part of spinal accessory nerve pass through this

and exit the cranial cavity.^[2] The neural and vascular compartments are generally separated by a bone projection called the intrajugular process.^[3-5]

The foramen can have many variations in its shape and size. The so-called anomalies of the jugular bulb such as glomeric tumors are related with the jugular foramen, as they come in direct contact with structures that cross it, like the internal jugular vein, the internal carotid artery, and the cranial nerves. Moreover, schwannomas, metastatic lesions and infiltrating inflammatory processes can also occur in the jugular foramen.^[1]

Microsurgical procedures, such as the lateral suboccipital access, have allowed for the removal of these lesions, which were formerly thought to be very difficult to undergo an operation.^[6,7]

Therefore, a detailed study and the knowledge about this foramen are needed.

Access this article online	
Quick Response Code:	Website: www.jcvjs.com
	DOI: 10.4103/0974-8237.142305

Hence, this study was carried out to analyze the shape, size, and presence of septa, presence of a domed bony roof and jugular fossa measurements of the jugular foramen in dry adult skulls.

MATERIALS AND METHODS

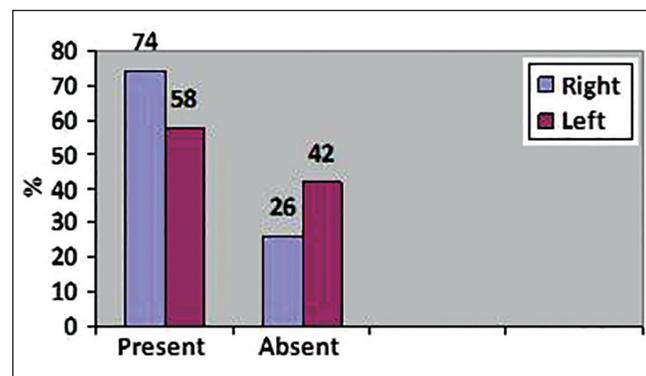
The study was conducted on 100 Jugular foramina from 50 dry skulls. All skulls were adult type and without any signs of erosion. Following parameters were studied: Side, latero-medial diameter, anteroposterior (A-P) diameter, area of jugular foramen, septations, presence of the dome, width and depth of the jugular fossa. Above parameters were measured using Vernier caliper and scale [Figure 1].

- Side: Right or left of foramen
- Latero - medial diameter: Maximum latero-medial diameter of the foramen
- A-P diameter: The A-P diameter of the foramen.
- Septations: Bony bridges dividing the foramen into compartments. Complete or incomplete.
- Dome: Presence or absence of domed bony roof.
- Width of jugular fossa: Maximum width of jugular fossa
- Depth of jugular fossa: If domed bony roof was present then depth of the jugular fossa was measured from the summit of the dome to the inferior border of the jugular fossa.
- Area: Area of jugular foramen was calculated.

Statistical analysis of all the parameters was performed using IBM SPSS Statistics for Windows version 20.0, USA. Comparison was done between right and left parameters.

RESULTS

The mean and range of all the parameters of right and left side jugular foramen and jugular fossa is shown in Tables 1 and 2.



Graph 1: Presence or absence of dome

Presence or absence of the dome on right and left side in jugular foramen is shown in Graph 1 and Figure 2. Presence of complete and incomplete septation on both right and left side in jugular foramen is shown in Graph 2 and Figure 3.

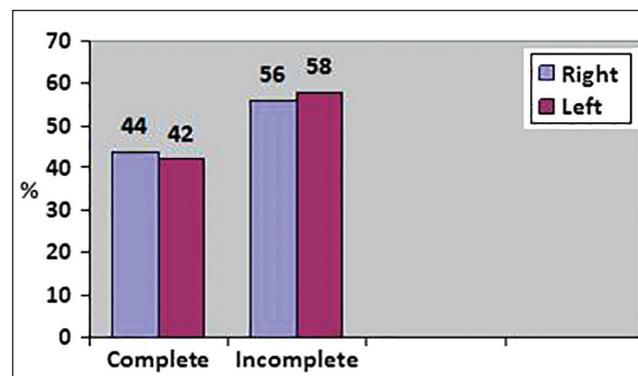
There was a significant difference between right and left area, and A-P diameter of jugular foramen as the $P = 0.000 (<0.05)$. However, there was no significant difference between the right and left latero-medial diameter of jugular foramen as $P = 0.129 (>0.05)$.

There was also a significant difference between right and left width of the jugular fossa as the $P = 0.016 (<0.05)$. However, there was no significant difference between the right and left depth of the jugular fossa as $P = 0.602 (>0.05)$.

DISCUSSION

The jugular foramen is difficult to understand and to access surgically; the problems in exposing this foramen are due to its deep position and the adjacent structures such as carotid artery anteriorly, the facial nerve laterally, hypoglossal nerve medially and vertebral artery inferiorly. The size and shape of the jugular foramen are associated to the size of the internal jugular vein and the presence or absence of a dome for superior bulb the right foramen is frequently larger than the left. The dissimilarity in size of the two internal jugular veins is already noticeable in the human embryo at the 23 mm stage and perhaps is due to the differences in the pattern of development of the right and left brachiocephalic veins.^[8]

Osunwoke *et al.*, Idowu, Vijisha *et al.* found the mean length of the right and left jugular foramen as 15.76, 13.90, 17.33 mm and 13.39, 14.11, 15.3 mm respectively, while the mean width of the right and left jugular foramen was 9.34, 10.22, 12.13 mm



Graph 2: Presence of complete and incomplete septation

Table 1: Mean and range of all parameters of jugular foramen on both right and left side

Parameters	A-P diameter		Latero-medial diameter		Area	
	Right	Left	Right	Left	Right	Left
Mean±SD	11.22±2.47	9.52±1.55	16.52±2.03	16.02±2.20	187.34±55.62	153.20±35.80
Range	8-19	6-13	12-21	12-20	96-357	72-247

SD: Standard deviation, A-P: Anteroposterior

Table 2: Mean and range of all parameters of jugular fossa on both right and left side

Parameters	Width of jugular fossa		Depth of jugular fossa	
	Right	Left	Right	Left
Mean±SD	6.83±1.50	5.69±1.60	11.75±3.50	11.13±3.54
Range	4-11	3-10	5-17	4-18

SD: Standard deviation

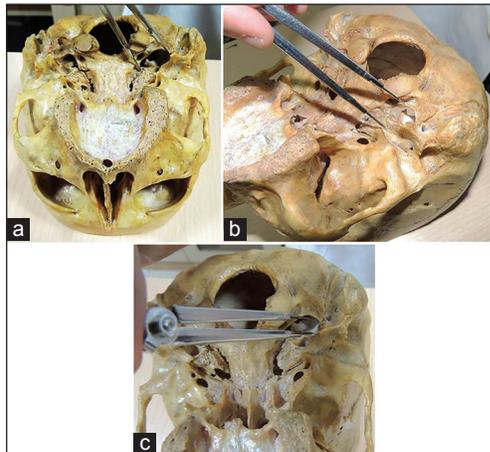


Figure 1: Measurements done on jugular foramen and fossa. (a) Mediolateral length of jugular foramen. (b) Anteroposterior length of jugular foramen. (c) Width of jugular fossa

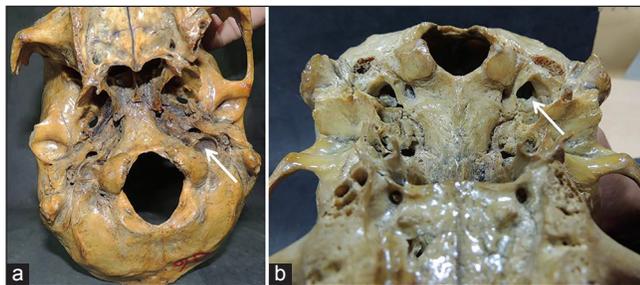


Figure 2: Presence or absence of domed bony roof. (a) Domed roof present. (b) Absence of domed bony roof

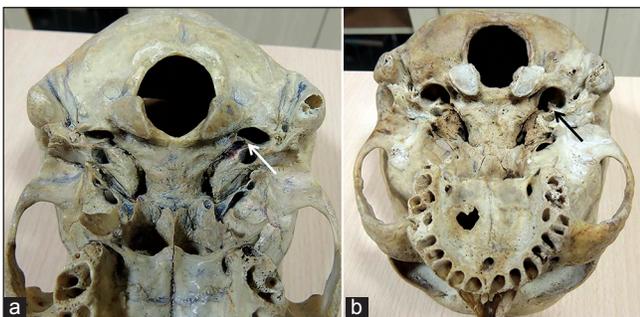


Figure 3: Complete and incomplete septation of jugular foramen. (a) Complete septum. (b) Incomplete septum

and 7.54, 9.57, 9.27 mm respectively. However in our study, we found the mean length, width on right and left side as 11.22, 16.52 and 9.52, 16.02 mm, respectively. Our width was

more than their width and length was less than their length this may be because they have done a study in different race (Nigerians and north Indians) and we have done in south Indian population. They also found that the right jugular foramen was larger than the left that we also got in our study.^[2,7,9]

Idowu, Vijisha *et al.* found the mean area of jugular foramen on the right was 437.4, 210.87 mm and that on the left was 419.48, 141.93 mm while in our study it was less it was 187.34 mm on the right side and 153.2 mm on the left side. This difference in Idowu values and ours may be due to racial variation, but our values are almost similar to Vijisha *et al.* They found no statistical significant difference in any parameter on right and left side. But in our study, we found statistical significant difference between right and left area and A-P diameter of jugular foramen. But in our study, there was no significant difference between the right and left latero-medial diameter of jugular foramen.^[2,7]

Khanday *et al.* found that in 40% and 29% of cases dome was present on right and left side while in our study it was found in 74% and 58% of cases on the right and left side respectively. They found the mean right and left A-P diameter, latero-medial diameter, area of jugular foramen as 10.06, 14.6, 118 mm and 8.9, 13.9, 90 mm. While in our study we got the values as 11.22, 16.52, 187.34 mm and 9.52, 16.02, 153.2 mm.^[8]

Singla *et al.* found the mean right and left A-P diameter, latero-medial diameter of jugular foramen, width, depth of jugular fossa as 9.32, 15.67, 8.99, 11.11 mm and 7.34, 14.85, 7.54, 11.04 mm. While in our study we got the values as 11.22, 16.52, 6.83, 11.58 mm and 9.52, 16.02, 5.69, 11.13 mm.^[10]

Singla *et al.*, Sturrock, Saheb *et al.*, patel MM and singel TC found the domed bony roof in jugular foramen in 72, 30.1, 49, 38.5% on the right side and 82, 6.4, 36, 14.3% on the left side while in our study we got that in 74% and 58% of cases.^[10-13]

Pereira *et al.* found the mean right and left A-P diameter, latero-medial diameter of jugular foramen as 9.21, 15.82 mm and 8.65, 15.86 mm while in our study the values are 11.22, 16.52 mm and 9.52, 16.02 mm. Our values are slightly more than their values this may be because they have done a study in Brazilian population, and we have done a study in Indian population.^[1]

Vijisha *et al.*, Sturrock, Hatiboglu and Anil found partial septum in jugular foramen in 73.3, 1.3, 2.6% on the right side and 80, 10.9, 19.6% on the left side while in our study we got that in 56% on the right side and 58% on the left side of cases.^[2,3,11]

Tumors involving jugular foramen and nearby structure requires microsurgical approach to enter into this region. In most of the cases, we have to drill the nearby bones around the jugular foramen for proper exposure. And the tumor tends to alter the normal anatomy of the foramen by eroding and invading it. Therefore, it is not possible to have correct anatomic visualization of the foramen in presence of such pathologies. Hence, a detailed knowledge of the jugular foramen is needed to all the neurosurgeons while doing surgery in this region.^[10]

REFERENCES

1. Pereira GA, Lopes PT, Santos AM. Morphometric aspects of the jugular foramen in dry skulls of adult individuals in Southern Brazil. *J Morphol Sci* 2010;27:3-5.
2. Vijisha P, Bilodi AK, Lokeshmaran. Morphometric study of jugular foramen in Tamil Nadu region. *Natl J Clin Anat* 2013;2:71-4.
3. Hatiboglu MT, Anil A. Structural variations in the jugular foramen of the human skull. *J Anat* 1992;180:191-6.
4. Prades JM, Martin CH, Veyret CH, Merzougui N, Chelikh L. Anatomic basis of the infratemporal approach of the jugular foramen. *Surg Radiol Anat* 1994;16:11-20.
5. Williams P, Warwick R, Dyson M, Bannister L. *Gray Anatomia*. 37th ed., Vol. 2. Rio de Janeiro: Guanabara Koogan; 1995. p. 329-31.
6. Guido H, Zorzetto N. Observações anatômicas sobre o forame jugular. *Rev Bras de Otorrinolaringol* 1997;63:541-7.
7. Idowu OE. The jugular foramen – A morphometric study. *Folia Morphol (Warsz)* 2004;63:419-22.
8. Khanday S, Subramanian RM, Rajendran M, Hassan AU, Khan SH. Morphological and morphometric study of jugular Foramen in South Indian population. *Int J Anat Res* 2013;1:122-7.
9. Osunwoke EA, Oladipo GS, Gwunireama IU, Ngaokere JO. Morphometric analysis of the foramen magnum and jugular foramen in adult skulls in Southern Nigerian population. *Am J Sci Ind Res* 2012;3:446-8.
10. Singla A, Sahni D, Aggrawal A, Gupta T, Kaur H. Morphometric study of the jugular foramen in North West Indian population. *J Postgrad Med Educ Res* 2012;46:165-71.
11. Sturrock RR. Variations in the structure of the jugular foramen of the human skull. *J Anat* 1988;160:227-30.
12. Patel MM, Singel TC. Variations in the structure of the jugular foramen of the human skull of the Saurashtra region. *J Anat Soc India* 2007;56:34-7.
13. Saheb HS, Mavishetter GF, Thomas ST, Prasanna LC, Muralidhar PA. Morphometric study of the jugular foramen in human adult skulls of South India. *J Biomed Sci Res* 2010;2:240-3.

How to cite this article: Gupta C, Kurian P, Seva KN, Kalthur SG, D'Souza AS. A morphological and morphometric study of jugular foramen in dry skulls with its clinical implications. *J Craniovert Jun Spine* 2014;5:118-21.

Source of Support: Nil, **Conflict of Interest:** None declared.

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